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ABSTRACT

To what extent can photographic readability be formalized for use as a criterion in the evaluation of instructional materials? The purpose of this study was to develop and pilot test a readability index for evaluating photographic illustrations in instructional materials. The index uses an interdisciplinary battery of methods adapted from the fields of linguistics, reading, and cognitive psychology to assess the level of visual information processing for viewers in both initial perception and prolonged encoding phases. The Picture Readability Index investigates both stages in the perception of photographs according to the comparison of affective and cognitive domain classifications on a nomograph format. Visual semiotic analysis is also used to investigate ways in which pictorial elements group to form functional ensembles or gestalts in the first eye centrations. An expert or adoption panel was used to improve the instrument during development. The present format is considered too extensive to use with large populations and in applications with limited time, even though the expert panel suggests that most of the elements included are important. Length could be made more manageable if all components were shortened. (Contains 20 references.) (Author/SLD)

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AN INTERDISCIPLINARY APPROACH TO THE EVALUATION OF VISUALS FOR INSTRUCTION

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Abstract

To what extent can photographic readability be formalized for use as a criterion in the evaluation of instructional materials? The purpose of this study was to develop and pilot test a readability index for evaluating photographic illustrations in instructional materials. The index utilizes an interdisciplinary battery of methods adapted from the fields of linguistics, reading, and cognitive psychology. It assesses the level of visual information processing for viewers of particular photographs in both initial perception and prolonged encoding phases.

The initial phase gathers information on how a viewer perceives a photograph during an initial brief period, that is, at a first glance. The latter phase entails extended exposure to the photograph and endeavors to reveal how a viewer encodes information while being influenced by a caption.

A Picture Readability Index (PRI) investigates the initial and prolonged stages in the perception of photographs, according to the comparison of affective and cognitive domain classifications, on a nomograph format. Visual semiotic analysis is also used to investigate ways in which pictorial elements group to form functional ensembles or gestalts in the first eye centrations. An expert or adoption panel was used to improve or edit the instrument in the development phase.

REVIEW OF LITERATURE

Advanced Organizer

Ausubel (1968) applies cognitive processing principles to education through the advanced organizer concept. Learning is primarily determined by a student's attitude towards the text. Advanced organizers depend upon "initial and successive presentation of the learning task" or objective (p. 274). They start with general information and end in specific. The general information presents only what students already know, thus drawing up preexisting schemata upon which students may build new information.

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Shepard (1978) postulated that the mnemonic power of images is contingent on a dual coding mechanism. The dual code consists of both mental images and verbal representations. Because images are stored both ways, information is easier to recall. Images in the context of text force summation of cues between two channels (Fleming 1979, p. 245). The verbal is processed as a serial experience, and the visual enables the learner to explore the scene for elements most relevant. Levie (1978) found that pictures helped adults learn only information covered in the text. Information that was not paralleled in text form was not learned (p. 37). A caption initiates this reciprocal textual relationship by reducing noise in processing and forcing perception onto the important, excluding the irrelevant or noisy component. If caption and text interfere with each other there is a good chance that they will cancel each other out. When word and image are effectively combined, they "penetrate deeply the invisible world of verbal learning" (p. 245). It is difficult to define operationally the interaction between word and text because it requires separation of visual and verbal elements, entwined in the relationship. It is impossible to define the effectiveness of instructional photographs independent of their objective, contained in the textual component.

Visual Information Processing

The foundations of visual literacy are found within the visual information processing principles of cognitive psychology. Visual information processing consists of two phases. The first phase is an initial group of rapid eye fixations or saccades (Spoehr & Lehmkuhle, 1982). This initial phase strives to bring organization to visual elements in an image. The organization is based on gestalts, which are common affinities to organize elements according to perceptual rules. These rules include distinguishing of figure from ground, symmetry and association of elements which are similar and in close proximity. The second phase is a subsequent group of eye fixations that serves to match a final cognitive schemata with incoming information.

The initial phase corresponds to a template component of pattern recognition. The pattern sensitivities derive from cortical brain cell pattern receptors discovered through brain hemisphere specialization research (Lennie, 1980). These templates were initially described by viewer interview techniques used by gestalt psychologists (Wertheimer, 1958). The subsequent extended phase derived from cognitive memory research that identified the schemata as an organizational prototype (Franks & Bransford, 1971; Rosch & Mervis, 1975).

Formalized Visual Criteria

Much research has been conducted into the comparison of different forms of media such as television versus textbooks, but a majority of the findings indicate no significant difference (Wilkinson, 1980). Potential research into the development of criteria for visuals is more effective when instructional uses of media are defined as a cognitively mediated process rather than when research is conceived as an environmental product, such as a media format. Winn (1982) concurred in that "internal processes and not external forms must be considered first" (p. 6).

Visual preferences can operate at a subconscious level, which makes them ideal for use in marketing and advertising, but less than ideal for media evaluation procedures. Decisions in the visual realm are often based on what looks good, rather than what constitutes the best instructional image. Preference does not necessarily correlate with instructional relevance. Preferences on appearance are taken from general, global impressions which media publishers are routinely trying to mold to their advantage.

Establishing Criteria

An example of an effective measure used in adoption decisions is text readability. Text readability has developed from a crude means to classify subjective judgment on text characteristics, to a more theoretical position which compares these attributes with learner characteristics (Zakaluk & Samuels, 1988). Visual readability may be following a similar, evolutionary path as text readability. Visual readability is presently in an early atomistic form. It is fragmented in the sense that picture attributes are often isolated from their media format in cognitive science. In educational media research, medium format is often analyzed holistically, without delineating attributes.

Although readability has been a component of textbook evaluation for 70 years, textbook illustrations have not enjoyed the availability of a comparable instrument. A variety of general purpose media selection models have been based on expert advice or opinion. An early example of such guidelines for selection is "truth, photographic quality, relevancy and relative size of items" (Hoban, 1937, p. 160).

A more current example of standards applied to photography is: "Are the still pictures attractive?... Do the still pictures have display value?... stimulate critical thinking?... Simple and distinct?... interesting and stimulating?" (Beatty, 1981, p. 18).

RESEARCH PROCEDURES

Images can be readable in the sense that they inspire complete cognitive and affective processing. Photographs with low readability inspire reactions that do not go beyond initial first glance emotional responses, stereotypes and premature conclusions. The PRI was designed to be used as a tool that describes photographs according to the affective and cognitive domains and how viewers are influenced by captions. Semiotic techniques explore the viewer's interpretation of visual grammar. Readability is determined by using a descriptive semiotic questionnaire that is based on a two-phase model of pattern recognition.

Research Design

PHASE I- Brief Duration

1) Brief display of the photograph
2) Viewer directed to draw major elements
3) Affective questioning
4) Coding of responses to domain

PHASE II- Extended Duration

1) Prolonged exposure to photo and caption
2) Cognitive questioning
3) Coding of responses to domain
4) For visual data presentation the viewer drawing from Phase I is labeled with the relationships between form established in the Phase II questionnaire

Data Coding

1) Enter coded data on nomograph
2) Determine the readability index by drawing a line between the affective and cognitive axis
3) Present results of pilot to a panel of adoption experts

Instrumentation

The PRI instrument was constructed from a variety of principles and components.

I. Short interval display of images, used to assess initial perception of gestalt, derived from perceptual threshold experiments first conducted by researchers at the turn of the century. Sperling's (1960) replication and refinements of early experiments standardized an initial perceptual threshold of 1/2 second as the average time necessary to perceive a minimal gestalt of simple forms. Sperling's experimental procedure for tachistoscopic display was replicated in the initial short duration phase.

II. Immediately following the display of short duration stimulus, viewers were instructed to draw representations of basic forms. These forms were used as aids to short term memory, necessary for completion of the short duration phase questionnaire, and for the subsequent interpretation of the data.

III. Short duration questionnaire items were written for each level of Krathwohl's (1964) affective domain.

IV. In the second phase, the photograph and caption were provided for consultation during the completion of a cognitive questionnaire.

V. Saint-Martin's (1990) syntactic technique was used as a visual data interpretation technique for information gained from the questionnaires. A syntactic drawing was labeled with relationships between visual variables for each photograph.

   A. A viewer drawing of the brief display of an image serves to identify elements that attract peripheral visual attention. Recognition of the elements was recorded at the first receiving level of the affective questionnaire. This level probes the awareness of basic visual elements.

   B. Depiction of the image according to subsequent extended foveal/macular vision account for gestalt relationships between visual elements such as the "presence of a "good form" and "figure/ground" productions (p. 204). Information on these relationships between visual elements was gathered from the analysis level of the cognitive questionnaire.

C. Syntactic analysis adds detail to information gained from the initial drawing. Information from the initial drawings are labeled according to the basic forms recognized in the responding level of the affective questionnaire and the relationships between these forms coded in the analysis level of the cognitive questionnaire.
A syntactic "system of notation" was used to label these relationships (p. 243). The drawing is termed syntactic because it refers to the syntax of visual language, or the way in which visual elements are related. Leading lines derive from the perceptual tensions imposed by Saint-Martin's "energetic charges of the basic plane" (pp. 183-225). This basic plane is a reflection of the distribution of rods and cones in the eye and the results of eye fixation preferences.

VI. Zakaluk and Samuel's (1988) two factor reading comprehensibility nomograph was adapted to accept short duration (affective) and prolonged duration (cognitive) classification data. This nomograph provides an interrelation, in the form of a readability measure.

Data Form

Data collected from the affective and cognitive questionnaires were in the form of scores for the five levels that contain 14-19 questions each, or a total of 77 questions for the affective and 80 for the cognitive. These scores were plotted on a readability nomograph to determine an individual subjective value of high, average or low readability. This data is analyzed via syntactic drawing.

Validity, Reliability and Limitations

Krathwohl was aware of possible limitations and was reluctant to publish the affective domain because it was considered speculative in comparison to Bloom's cognitive domain: "we present it with some trepidation and full expectation of severe criticisms from many quarters" (1964, p. 14). The purpose of the affective domain is to "provide greater precision in specification."

Bloom suggests that one of the major potential limitations to the cognitive domain was the level of generality which should be set "where the loss by fragmentation would not be too great" (1956, p. 5). For visual material the risk of fragmentation is potentially higher than for textual material. Visual images often contain a far greater variety of potential interpretations than textual components. Adapting the cognitive domain for photographic material might be overstructuring or limiting the potential for expression. To keep the structure manageable, the cognitive levels

(and the affective as well) were not broken into sub-levels but into sub-questions or examples of situations. These lists of sub-questions at each level ranged from 15-25 items.

Relation of Factors on Nomograph

This study used the levels of the cognitive and affective domains to structure questioning. The scores from the questionnaire indicate the level students have reached on the domains. The depth of processing or level reached on the individual domains were interrelated on a nomograph to produce a PRI.

Pettersson realized that any measure of a picture's readability had to integrate the affective and cognitive domains (1989). His efforts were hindered in that variables are "very hard to isolate and rate the importance of" (p. 156). Pettersson concluded that "future research in this field will probably have to use sets of actual test pictures" and to take into account that an "information dissemination picture also conveys emotions" (p. 161). Pettersson's suggestions for the development of a PRI shaped the structure of how affective and cognitive data would be collected and interrelated in the pilot study.

The specific procedures of interrelating the affective and cognitive scores into one rating was suggested by Krathwohl's (1964) description of the domains as: analogous to a person scaling a wall using two step ladders side by side, each with rungs too wide apart to be conventionally reached in a single step... the attainment of some complex goal is made possible by alternatively climbing a rung on one ladder which brings the next rung of the other ladder within reach (p. 60). This analogy illustrates the one sided or one ladder nature of much evaluation literature. The intermixing of affective and cognitive in text readability formulae suggested the potential utility of the nomograph format.

CONCLUSIONS

The present format of the instrument is too extensive to be applied to large populations and for applications with limited time restraints. In-depth information was necessary for decoding complex affective responses, evidenced in many of the images that were analyzed in the pilot. All the elements devised in instrument development were used in the pilot for the purpose of deciphering which type of information would be the most valuable for textbook adoption decisions. The results of the expert panel discussions and evaluation of the instrument suggest that most of the elements of the instrument are important. Most of the data generated was considered "necessary" for the distinction of one group of images represented in a text over another. The length could be made more manageable if all the components were shortened based on the common objectives of the instructional images for particular applications.

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